



Industrial Monolayers for Nano Patterning

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Nano patterning

1.0 Definition

Clusters and colloids are small structures made of several thousand atoms. They can be thought of as a bridge between the atomic (very small) and bulk (large) size structures. The production of nanometer-size devices implies that material can be manipulated at this scale in a controlled manner. Future computers based on microelectronics include single-electron transistors, molecular switches as well as quantum arrays.

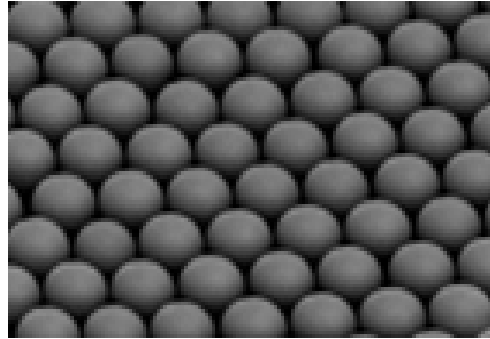


Figure 1.0

Nanometrix technology opens the possibility to fabricate in an industrial and continuous way hexagonal close pack nanoscale arrays and patterning on different substrates with different materials.

Figure 1.0 shows a typical Silicon Oxide beads Monolayer obtained with Nanometrix Technology)

Fine metal particles in the nanometer size range find numerous applications in different fields such as catalysis, electronics, optics, as well as magnetic data storage. Several studies have shown that thousand- and hundred-atom transition metal clusters present electronic and magnetic properties that differ markedly from those of bulk materials. At the nanometer scale, many physical and chemical properties depend on the size and shape of the solid particles.

Therefore their use as advanced materials in high technology requires uniform particles with a controlled mean size and a narrow size distribution. Some of these particles have been used by Nanometrix for different projects: TiO₂, nano diamonds, PMMA and SiO₂ micro and sub-micron beads, to name a few. Many others have to be tested for further development and applications. These particles can be used as the final functional arrangement or as a passive template for further nanofabrication, architecture and patterning.

2.0 Nanometrix advantages

Recently, nanodot arrays have attracted a great attention because of their realization in functional structures and in the field of nanodevices. Many fields such as optics, electronics, information storage, and sensing are direct targets for

this technology. Although lithographic techniques offer good control over nanodot size, shape, and spacing, these techniques include expensive and time-consuming processes. Also, these techniques can be applied to only limited materials and on limited surface.

Nanometrix industrial method of monolayer fabrication fills the gap: Current production is made at a rate of one linear meter per minute in average. Flexible as well as rigid substrates have been coated successfully with various monolayer materials including oxides, metals, semiconductors polymers and organic compounds. Such 2-D particle arrays are interesting objects for direct applications as lithographic masks. Crystalline arrays of monodispersed spherical colloids have been demonstrated and proposed by Nanometrix for use in a wide variety of areas. Interesting examples include their use to obtain photonic crystals effects; as 2D structures to create crystallization and 3D nanotube growth; as templates to generate porous materials with highly ordered structures; as diffractive elements to fabricate optical switches and sensors as well as photonic band gap materials. These crystalline lattices are also useful in catalyst and energy production such as fuel cells. Nanometrix assembly process opens the gate to these substantial breakthroughs.

Figure 2.0 shows a monolayer of silicon oxide beads of 1 micron deposited on Aluminum foil at a rate of 1m/min.

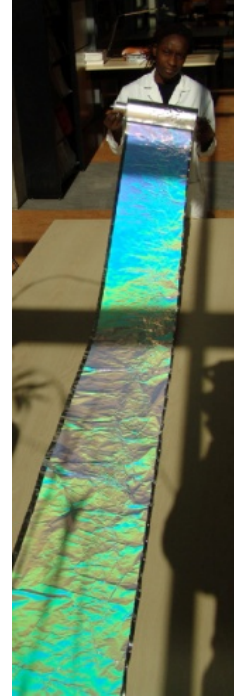


Figure 2.0

3.0 Nano patterning applications

3.1 Data and memory devices

Data storage can benefit from Nanometrix know-how and technology by using our capabilities to increase substantially the storage capabilities per unit area. Single magnetic unit of information needed 40 x 400 nm² surface in 2002. The smallest theoretical magnetic storage area is in the range of 10 x 10 nm². Some monodispersed particles can be monolayered by Nanometrix to create an hexagonal closed pack of magnetic nano dots at the 10 x 10 nm² scale mentioned above.

3.2 Anchorage for functionality

Many applications in the field of 3D growing such as carbon nano tubes or crystals can be foreseen in the near future. In fact, Nanometrix US patent pending concerns specifically on the use of the ability to produce 2D arrays for 3D extrusion and growing in a controlled manner. Same 2D arrays have been

used successfully as cell cage matrices for living cell study, bio-matter functional proteomics and high throughput screening, for drug and pesticides discovery and fabrication.

3.3 Patterning and colloids for electronics

As computer chips become smaller and smaller, quantum mechanical effects become more and more important. In principle, electronic devices using clusters as components could use these quantum mechanical effects to their advantage, resulting in a faster and more efficient computer. Measurements of the electrical properties of these arrays could lead to the first electronic devices using clusters as components. Metallic nanoclusters and molecular wires have been studied for some time as two active but distinct fields of development. Both expertises can be combined to fabricate a Linked Cluster Network (LCN): a two-dimensional superlattice consisting of nanometersized conductive clusters electronically linked by organic molecules.

4 Results

We have succeeded in forming ordered arrays of colloids on large scale substrates. Nanometrix could exploit the properties of electronically-linked or unlinked cluster networks in many fields of the electronic industry. These include devices and materials which employ nanoscale elements to realize (1) local interconnects for integrated circuits with minimum feature sizes of less than 0.01 micron, (2) electronic devices with extremely high densities of computational or memory cells, (3) chemical sensors with high sensitivity and selectivity, and cluster engineered materials with enhanced (4) optical and (5) magnetic properties.

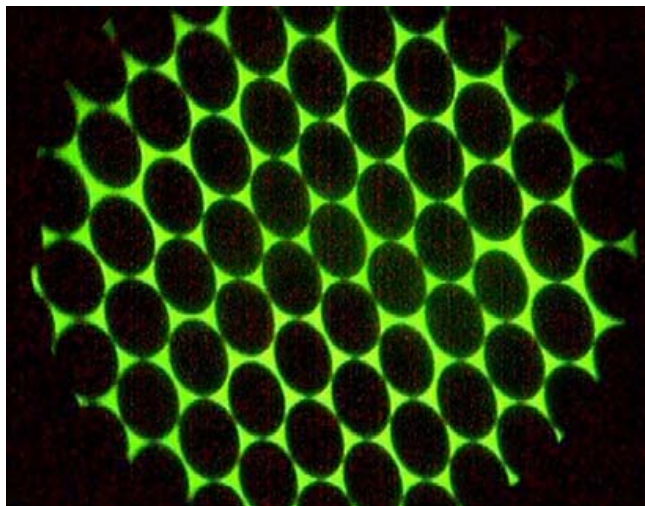


Figure 3.0

4.1 Nano Patterning for OLED Fabrication

Numerous advantages can be found with the utilisation of Nanometrix technology in order to fabricate cost effectively large scale arrays. In the same way, monolayers can be used as sacrificial mask for sputtering or other coating methods reproducing the interstitial patterning between the particles. Figure 4.1, 4.2 and 4.3 are good example of residual Gold nano patterning. 50 nm and 80 nm patterning was obtained after monolayer deposition, Gold sputtering and lift off of the monolayer was performed.

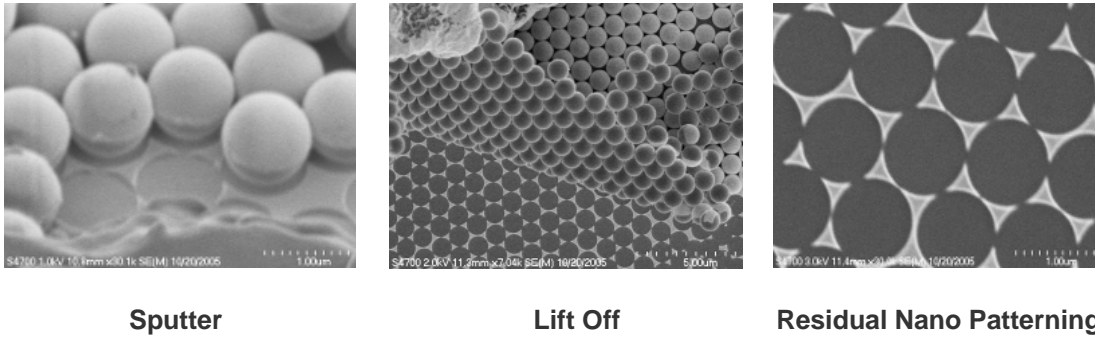


Figure 4.1, 4.2 and 4.3

Similar approach can be chosen for OLED's displays where the monolayer is used as sacrificial template for the electron/hole transporting layers as shown in Figure 5.0 Triple point stars are obtained in an hexagonal array as shown in figure 4.3.

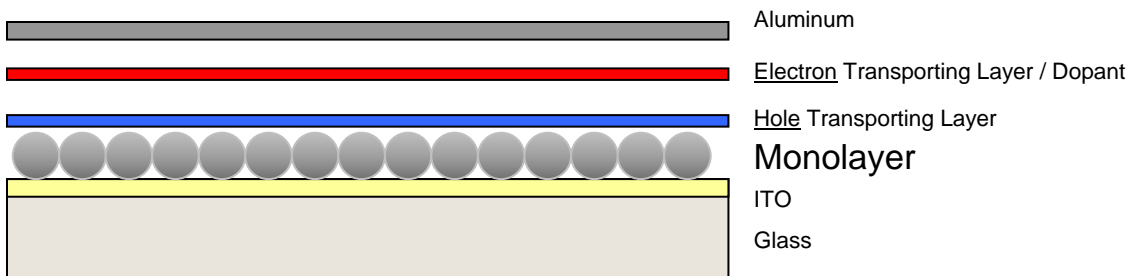


Figure 5.0

4.0 Conclusion

Timing is of great importance for commercialisation of new technology. Moore's Law predicts further development on miniaturisation. In the mean time, tremendous efforts have been done on characterisation tools, being a key factor in understanding nature's behaviour at the molecular scale. Nanometrix' breakthrough is the ability to bring a continuous and scalable process for the industry at the molecular scale and up. Nanometrix technology fabricates nanoscale patterning, surfaces and coatings for present needs and future ones.

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